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ALBERTA ENVIRONMENTAL CENTRE

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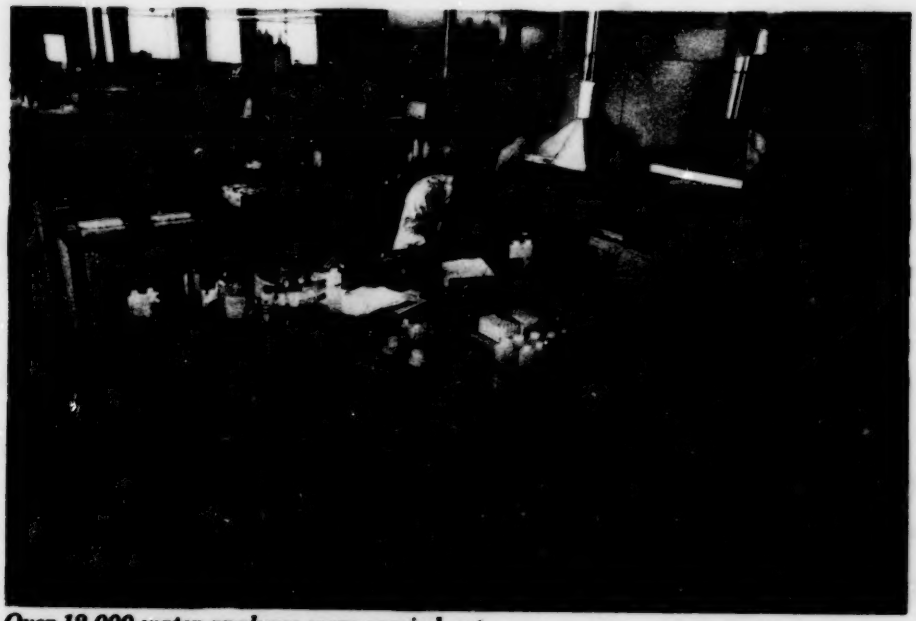
Introduction

The twelve months ending March 31, 1983 saw the Alberta Environmental Centre (AEC) complete its first full fiscal year of operation since the June, 1981, official opening. As a new facility with a unique mandate, the Centre carried out a growing range of work in the general areas of service, environmental research and technical development. Most work was done for Alberta government departments, local health authorities, and the Alberta Research Council while some was also carried out for the Muttart Conservatory, the Sam Livingston Fish Hatchery, other agencies and the public in fulfilling the Centre's mandate as the Provincial Government's central agency for the study and solution of environmental problems.

- **History and Mandate**
- **Facility**
- **Programs**



Over 12,000 water analyses were carried out.

HISTORY AND MANDATE: The history of the Alberta Environmental Centre (AEC) reached another landmark in 1982-83, the first complete fiscal year's operation since the facility was officially opened. Other milestones in AEC's history were:

— 1973, when the Alberta Government approved construction of the interdepartmental facility;

— 1977, when the main laboratory building in Vegreville, 100 km east of Edmonton, was tendered;

— 1979, when the first staff transferred to Vegreville;

— 1980 when the contract for the main laboratory building was completed;

— and 1981, when the facility was officially opened.

The 1982-83 fiscal year was one where major steps were taken to advance AEC's ability to provide answers to environmental problems identified by departments and agencies of the Government of Alberta. These included development of facilities and expertise required for the investigation of complex environmental questions. Increasingly, however, the advances were in the application of these resources to both specific and broad matters of concern to government. This was reflected in a growing amount of scientific and technical information generated by the Centre; an increased volume of physical, chemical and biological tests conducted; and a lengthening list of subjects under active investigation.

The Centre's mandate, in general, calls for work in the areas of analytical and diagnostic services, applied research and technical development. That work may be done, without cost to the client, for any department or agency which requests it. In practice, the main users of AEC services have been the Departments of Environment, Agriculture, Energy and Natural Resources, Workers' Health, Safety and Compensation, the Alberta Research Council, and Health Units throughout Alberta.

FACILITY: AEC is located on a 750-acre (approximately 300-hectare) site in Vegreville, 100 km east of Edmonton. The heart of the facility is the 16,700 square-metre main laboratory building which is divided into five Wings — Common Services, Plant Sciences, Chemistry, Animal Sciences and Environmental Technology.

As a new facility, the Centre has acquired state-of-the-art instrumentation for its laboratories. New equipment acquired during the year included plant growth chambers, a microbiological fermenter, an electron microscope and a waste incinerator. Some unfinished laboratory areas were developed to accommodate new programs.

In addition to the main laboratory building, the Centre has a 3,000 square-metre services building, a 100 square-metre interim laboratory waste treatment system and four waste storage lagoons.

PROGRAMS AND PROJECT DEVELOPMENT: Work at the Centre is unique in that it is inter-departmental and interdisciplinary. All work originates with client departments or agencies which recognize a need for the activity. Once approved, much of that work is tackled by teams comprised of people with advanced training in one of several areas of the natural or physical sciences.

An approval process, involving personnel from AEC and the client department, insures that work is timely, relevant and complete. A Technical Advisory Committee (TAC) of the client agencies' senior technical staff makes program proposals to AEC. After review by AEC staff, proposals go back to the TAC, which circulates them within departments for comments. The TAC finally sends proposals to the AEC Board of Directors made up of Deputy Ministers from client departments and the Centre's Executive Director. The Board sends its recommendations to the Minister of Alberta Environment.

The interdisciplinary team approach is applied where possible to the approved programs and projects. This relatively untried method of research management, while difficult, was selected as having the potential to produce superior results, particularly when applied to environmental studies.

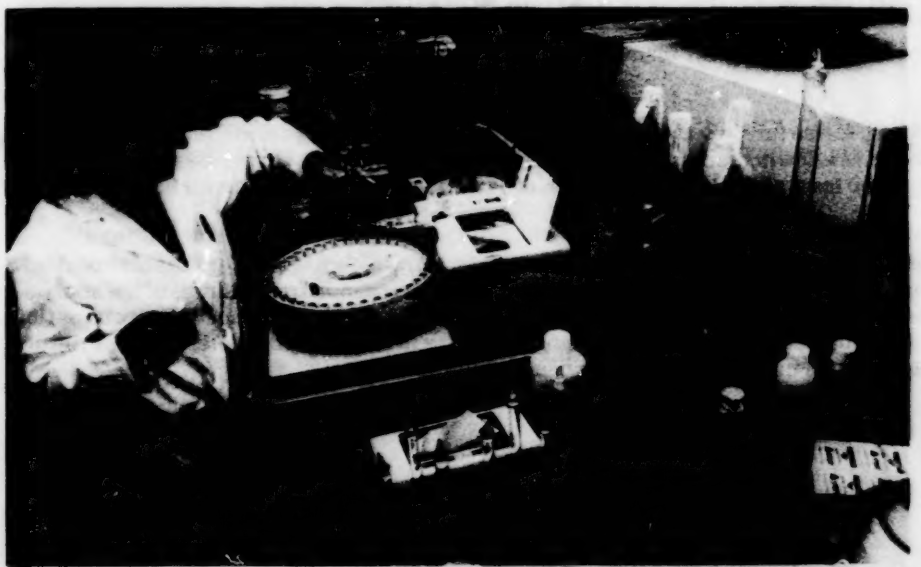
Environmentally controlled growth chambers were used for trials on canola pest control.

Analytical, Diagnostic, Extension and Technical Services

This Program Area provided the majority of the Centre's services offered to government departments and agencies and, in some cases, directly to the public. Work on the detection, description and understanding of environmental agents and substances ranged from operation of the province's main laboratory for drinking water testing to providing more specialized services such as identifying microorganisms. As well as the following major programs, services were offered in such areas as feed analysis, animal maintenance, wildlife capture, vertebrate pest diagnostics, and animal pathology services.

PROGRAMS

- Pest Management Diagnostic and Extension Services
- Microbiological Identification Services
- Trace Organics Analysis and Methods Development
- Analytical Services (Air)
- Precipitation Studies
- Analytical Services (Water)
- Toxicology Services
- Geochronology Services
- Lake Nutrients
- Aquatic Biology Services
- Quality Control and Data Management



The Water Analysis and Research Group tested drinking water samples from Health Units across Alberta.

Program: PEST MANAGEMENT DIAGNOSTIC AND EXTENSION SERVICES

Objectives: To provide insect, plant disease, weed, and chemical damage diagnostic and extension services.

Progress: Over 3400 insect, plant, soil and similar samples were diagnosed in Centre laboratories. This represented an increase over last year in all classes of submissions. The largest increase, to 1085 samples, was in the number of plant, soil and water specimens examined in cases of suspected chemical damage to plants. Related greenhouse trials were performed to develop biological tests for three herbicides in soil. In another 36 field trials, effects of herbicides and their soil residues on plants were studied.

A further 329 plant specimens were identified in the weed diagnostic laboratory. As an aid to these identifications, a weed garden containing some 55 reference species was maintained.

Of the 1370 plant samples submitted for disease diagnosis, 75 per cent were ornamental, vegetable and fruit plants. Most of the remainder were cereals, oilseeds, shelterbelts and forages. As well as laboratory diagnostics, staff members carried out on-site crop and greenhouse disease investigations as required.

Ornamental and horticultural crop pests made up 48 per cent of insect diagnoses. Another 34 per cent were for insects of household and public health concern, diagnosed mainly for provincial Health Units.

The number of plant and insect diagnoses carried out was:

	1980-81	1981-82	1982-83
Insects	597	592	678
Plant diseases	931	1027	1370
Weeds	360	315	329
Chemical damage	554	730	1085
	2442	2664	3462

Extension, advisory and education activities ranged from responding to pest control inquiries to giving courses and writing pest control booklets and leaflets. An extension bulletin 'Biological Pest Management for Interior Plantscapes' and 32 plant disease information leaflets were published and distributed. When needed, backup diagnostic services were provided to Alberta Agriculture Regional Crop Laboratories.

Program: MICROBIOLOGICAL IDENTIFICATION SERVICES

Objectives: To provide microbiological identification services including identification, isolation and counting.

Progress: The service became fully operational following a two-stage development process: (1) a 16-test rapid identification series allowing identification to the genus level; and (2) a comprehensive identification consisting of up to 50 tests allowing identification of bacteria and yeast to the genus and often to the species level.

Some 1,050 samples were tested for microorganisms in wastes and surface waters, plants and bears. A report on predominant aerobic microflora of black and grizzly bears summarized findings of the analysis of 56 swabs collected from various body sites on trapped bears. The analysis included an examination and identification of 225 bacteria, 42 yeast and 27 fungal isolates in an attempt to determine the nature and types of microorganisms naturally present in bear populations.

Program: TRACE ORGANICS ANALYSIS AND METHODS DEVELOPMENT

Objectives: To provide trace organic compound analytical services, excluding pesticides.

Progress: A priority pollutant analytical scan was introduced for 79 organic compounds suggested as being harmful to the environment. These compounds were selected almost exclusively from the U.S. Environmental Protection Agency list of priority compounds, excluding metals and some organic compounds. Steps were taken to expand the number of compounds in the scan. The priority pollutant scan was applied to 132 samples in its six months of operation, representing around 12,000 tests.

In the fiscal year, a total of 361 samples was tested for a range of characteristics and constituents. Of these, 70 per cent were conducted for Alberta Environment's Pollution Control Division, 14 per cent were for Centre projects and 11 per cent were for provincial Health Units.

Program: ANALYTICAL SERVICES (AIR)

Objectives: To provide chemical analysis for provincial government environmental surveillance, regulatory and enforcement programs.

Progress: Routine air quality analyses were performed on gases from industrial smoke stacks as well as on ambient air. Stack emissions were analyzed from 11 industrial plants including chemical, cement and fertilizer plants and pulp and paper mills. A total of 278 such samples were analyzed with 659 tests, providing data for enforcement and licensing personnel in Alberta Environment.

Some 7,041 samples were collected and 11,585 tests performed in the ambient air testing project. Air was tested for particulates, lead and other metals, benzo(a) pyrene, hydrogen sulphide and other sulphur gases, fluorides and nitrogen oxides following collection from air monitoring stations throughout Alberta. As well, 1,540 tests were conducted on 1,315 samples in a vinyl chloride monitoring project.

Development of new test methods for substances in air continued. A new test for lead in ambient air was developed, proving superior to the previous procedure. A method of detecting 15 common herbicides or pesticides in ambient air was also developed, and a study on vinyl chloride sampling efficiency was completed.

Program: PRECIPITATION STUDIES

Objectives: To develop test methods and to analyze wet and dry depositions in Alberta.

Progress: The Centre participated with Alberta Environment's Research Management Division in an 'acid rain' study in the oil sands area of the province. Under the project a total of 348 rain and snow samples was subjected to 4,210 tests.

A further 106 rain samples were routinely analyzed with 1,272 tests for substances and characteristics including pH, conductivity and specific ions. Samples were collected from several monitoring stations in the province.

Quality control activities in this program included studies with provincial industrial laboratories and the Federal Government to assure the accuracy of analytical data.

Program: ANALYTICAL SERVICES (WATER)

Objectives: To provide water analysis services to provincial Health Units and other users.

Progress: Demand for analysis of water and related samples grew to a total of 12,875 samples submitted, requiring 215,500 individual tests. The majority of samples, 10,208 requiring approximately 150,000 tests, was analyzed to determine the suitability of drinking water for human consumption. These samples were sent in by provincial Health Units.

A further 60,200 tests were performed on 2,351 samples submitted by Alberta Environment's Pollution Control Division. An increasing number of these samples was submitted on a rush or emergency basis and the number of legal samples handled was also up sharply.

Chemical tests carried out for AEC-managed programs totalled 20,200 on 960 samples in addition to the 12,875 samples received from outside sources.

A quality control program was continued to monitor the accuracy and precision of the data produced in the analysis program.

Program: TOXICOLOGY SERVICES

Objectives: To provide toxicological and biochemical services to clients including the Centre.

Progress: Staff were called on to give advice on fungal toxins following heavy ergot infestations of rye and other grains, and contamination of stored grains. Laboratory studies were conducted with ochratoxin A, a toxin produced by storage fungi. The study showed that while the toxin is difficult to remove from rat blood, changing the urinary pH may speed its elimination, thereby reducing its toxicity.

Advisory services were provided to Peace River area farmers concerned with possible effects of sulphur emissions on agriculture and soils, and to a series of public meetings on location of a hazardous wastes treatment facility.

A series of tests for enzymes in cattle was performed in support of other toxicological work. This included 80 analyses for an enzyme, glutathione peroxidase, absence of which points to selenium deficiency in cattle, 170 analyses for superoxide dismutase, an enzyme related to copper metabolism and deficiency, and 320 analyses in a study of the effects of cattle breed, age and sex on levels of acetylcholinesterase, an enzyme important in carrying nerve impulses.

Program: GEOCHRONOLOGY SERVICES

Objectives: To provide a carbon-14 and tritium low-level analysis service and applied research facility for the solution of environmental and general earth sciences problems.

Progress: The geochronology laboratory was developed to the point where samples could be accepted for analysis of isotopes at naturally occurring levels, providing a time-frame for the rate of change of many natural processes.

Progress was recorded in sample preparation for both carbon-14 and tritium, in development of instrumentation required for the dating process, and in associated computer software development. Real sample processing was initiated for systems cross checks and a survey of tritium concentrations in groundwater samples was conducted for the Alberta Research Council.

Program: LAKE NUTRIENTS

Objectives: To provide analytical support for lake eutrophication research primarily for nutrient parameters.

Progress: Water and sediment samples were analyzed for Alberta Environment's Pollution Control Division in support of research on nutrient levels in selected Alberta lakes. Most of the analytical work was performed on lake eutrophication samples, mainly from Lake Wabamun, the Cold Lake area and the North Saskatchewan River. A total of 27,065 tests was applied to 1,216 samples.

Program: AQUATIC BIOLOGY SERVICES

Objectives: To provide essential services to aquatic biology research programs including development of a treatment system providing water suitable for aquatic organism culturing and the supply of aquatic organisms to other research programs.

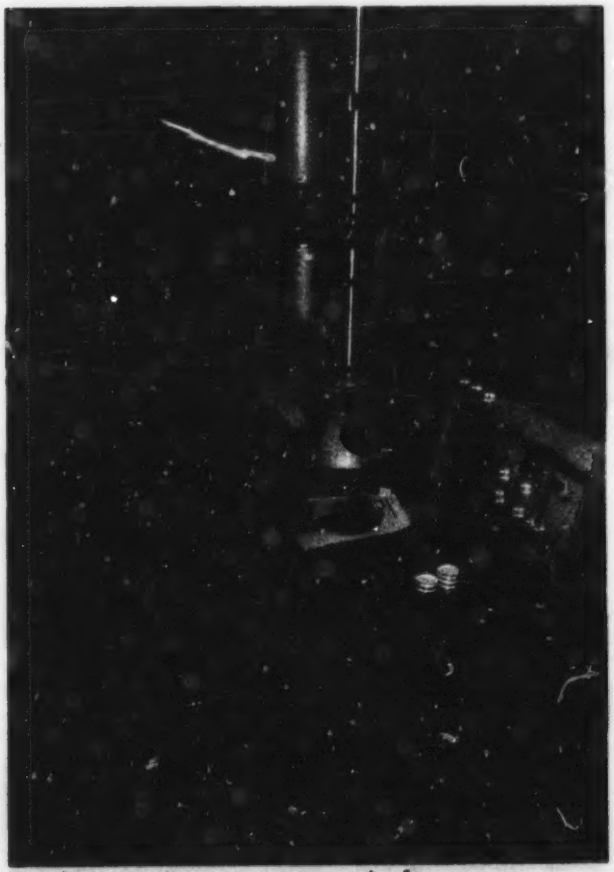
Progress: A recycle water treatment system to provide water for fish maintenance neared completion. The system includes a secondary treatment plant to treat and re-use water from fish tanks. Rainbow trout eggs were purchased from California and hatched in the Centre to provide fish for effluent toxicity tests. Staff were also active in organizing a workshop on aquatic toxicity which attracted delegates from seven countries.

Program: QUALITY CONTROL AND DATA MANAGEMENT

Objectives: To provide analytical reports in suitable forms and to prepare local and interlaboratory quality control samples to ensure the accuracy of analytical results.

Progress: A total of 15,051 chemical analysis reports were processed for clients of the Water Analysis and Research Section. Most of these were for provincial Health Units.

A three-laboratory interlab study of nutrients was completed, showing exceptionally good credibility of Centre data.



An electron microscope was acquired.

Pest Management Research and Development

Research into ways of reducing pest damage through the use of integrated, environmentally acceptable control methods made up the core of this Program Area. Work included an examination of chemical, cultural and biological control methods as well as chemical studies to detect and analyze pesticides in the environment.

PROGRAMS

- Plant Pathology Research and Development
- Insect Pest Management Research and Development
- Weed Management Research and Development
- Pesticide Analysis and Methods Development

Plant disease research was conducted by the Crop Protection Group.

Program: PLANT PATHOLOGY RESEARCH AND DEVELOPMENT

Objectives: To develop information required for the protection of field crops, ornamental plantings and turf in Alberta through applied research on plant disease prevention and control.

Progress: Field trials were completed on the use of seed treatments to control root rot and smut in barley, root rot in two wheat varieties, and damping off and seedling blight in three canola varieties. Trials in co-operation with Alberta Agriculture gave excellent control of sclerotinia white mold on Altex and Candle canola with significant yield increases.

The influence of herbicides on cereal disease development was studied in the laboratory prior to field trials. Preliminary laboratory studies were completed on the action of 10 herbicides on fungal development on cereals.

Soil samples were collected near Smoky Lake for sulphur analysis to find a site suitable for an investigation of the relationship between sulphur deficiency and alfalfa decline. Soil samples collected at the Centre were not sufficiently sulphur deficient.

Staff participated in four crop disease surveys:

- verticillium wilt of alfalfa, as part of a national survey in co-operation with Agriculture Canada (the disease was not found in the northeast region);
- blackleg of canola (the virulent strain was not found);
- ergot in wheat and root rot in cereals in co-operation with Agriculture Canada; and
- bacterial ring rot of potatoes in co-operation with Alberta Agriculture.

As part of the Centre's commitment to the verticillium wilt survey, tests on 86 verticillium isolates were completed.

Program: INSECT PEST MANAGEMENT RESEARCH AND DEVELOPMENT

Objectives: To develop information on the protection of ornamental and horticultural crops, field crops, livestock and poultry through insect pest management research.

Progress: Research and surveys were carried out on several important insect pests of ornamentals, horticultural and field crops, livestock and poultry.

Biological and chemical methods of controlling greenhouse crop insect pests were investigated. Good control of important pests was obtained with biological agents at the Muttart Conservatory in Edmonton. The introduction of insect predators and parasites reduced the need for insecticides.

Preliminary trials on the chemical control of chrysanthemum leafminer in greenhouses were completed. Four different chemical treatments were found effective. As well, a preliminary trial on chemical control of root maggots in rutabagas was carried out.

Field crop insect pest research concentrated on several aspects of bertha armyworm control in canola. To provide an early warning of potential outbreaks, work was completed on design of a bertha armyworm larval sampling method for farmers, and on attractiveness of canola to bertha armyworm adults. Research continued on sex attractant-baited traps to monitor the adult insects. Results were used to successfully forecast outbreaks. Studies were started to explain geographical variation in the effectiveness of the traps. Further work investigated chemical control of flea beetles in canola and use of sex attractant-baited traps to monitor clover cutworms in the Peace River region.

Impact of horn flies on range cattle productivity was one of the several projects undertaken on livestock insect pests. Use of ear tags and self-treatment oilers for chemical control of horn flies was evaluated. As well, a new fly control product for use in hog barns and a new wipe-on insecticide to protect horses from biting flies were tested. Whole-body application of insecticides to protect cattle from black flies was also examined.

Several surveys were carried out including one involving ten provincial grazing reserves to determine the distribution and abundance of face flies, an insect of potential economic importance in Alberta. Another survey was done to evaluate commercial hog operations for the presence of mange mites and to assess mange management practices. As well, the Centre's annual trapping survey for native and European elm bark beetles, carriers of Dutch elm disease, again detected no beetles. A province-wide survey of root maggot damage to canola was also undertaken.

Program: WEED MANAGEMENT RESEARCH AND DEVELOPMENT

Objectives: To determine through applied research the magnitude of weed problems and economic losses due to weeds in Alberta, to generate and develop information on weed management and to provide this information to the public.

Progress: Research projects were carried out on herbicides and weed control, on the biology and ecology of weeds, and on biological control of weeds. Herbicide work involved 53 field experiments in three areas: barley tolerance to herbicides; control of weeds and volunteer cereals in rapeseed; and rotational crop tolerance to herbicide residues in soil. Related greenhouse research was conducted on carryover of residues of three herbicides in soil from the 1982 research plots. Results were reported to weed research and extension agencies.

Weed biology and ecology research included studies on seed germination, emergence and growth characteristics of hempnettle, cleavers and scentless chamomile. Six laboratory experiments were conducted to determine the effect of temperature and seeding depth on germination of these weeds. A long-term experiment on the survival of seeds of 18 weed species in soil was started. As well a report was prepared on the effect of aqueous polyvinyl chloride leachates on seed germination and growth of selected crop species. Field research included 20 field trials to study biology and control of hempnettle, cleavers and scentless chamomile in cereals, crop yield losses due to tartary buckwheat and the influence of fertilizer placement on weed/crop competition for nutrients. Study of root-tip chromosomes was started in an effort to identify various biotypes of leafy spurge in Alberta.

In biological control research, imported insects were released in two locations, near Cardston for leafy spurge control, and near Wainwright for perennial sow thistle control.

Program: PESTICIDE ANALYSIS AND METHODS DEVELOPMENT

Objectives: To analyze pesticide residues in water, soil, sediment and other matrices and to develop the analytical methods for this work.

Progress: For the year, a total of 467 samples was analyzed for low levels of various pesticides in water, soil, sediment and other substances. Over 90 per cent of the samples were analyzed for Alberta Environment's Pollution Control Division, providing input into the Department's program of maintaining clean water standards and aiding in the formulation of recommendations for pesticide application rates. Pesticides analyzed on a regular basis included 2,4-D, 2,4,5-T, Dicamba, Trifluralin, Triallate, Paraquat, Carbofuran, Propoxur, Diuron and Simazine.

Provincial Health Units accounted for another five per cent of the samples submitted.

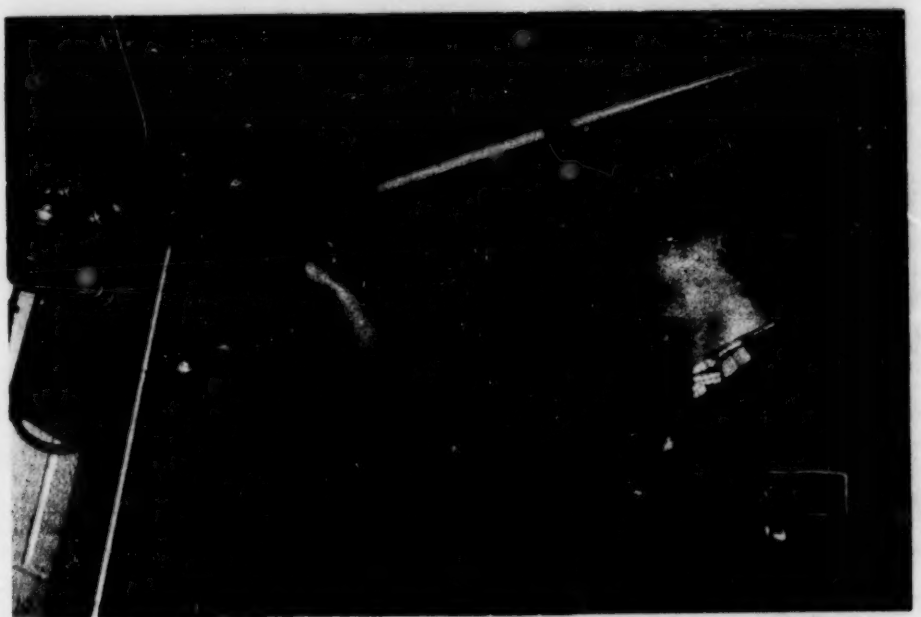
Work in developing chemical methods of analysis resulted in publication of several articles in scientific journals. Development work on the analysis of herbicides in soil and plant tissue continued.

Water/Wastewater Research and Development

Developing an understanding of the effects of wastewaters on aquatic life and a detailed description of processes affecting wastewater toxicity were among specific objectives in this Program Area. These projects, and work on water quality improvement processes, point toward the general objectives of ensuring good quality water is available for various uses while environmental impacts are kept to a minimum.

PROGRAMS

- **Environmental Chemistry of Wastewater**
- **Water Quality Improvement**
- **Aquatic Toxicology**



A reverse osmosis water treatment plant supplied deionized water to laboratories.

Project: ENVIRONMENTAL CHEMISTRY OF WASTEWATER

Objectives: To identify the toxic components of industrial effluents and to recommend methods of detoxification; to establish an environmental data base and monitor trends in aquatic contaminants in Alberta; and to determine their persistence, transformation, bioaccumulation and fate in the environment.

Progress: Experiments were conducted to determine which portions of an industrial effluent are toxic, thereby providing information useful for the purification of wastewater. Effluent from a metal refining and fertilizer complex was chosen for a test. A technique of separating the wastewater fractions, coupled with biological tests, was used to evaluate the toxicity of the various portions of the effluent.

A special scientific committee was formed to report on substances of environmental concern in Alberta waters. Its report identified the lack of information on several chemicals likely to occur in Alberta waters. Among its recommendations was undertaking of a comprehensive survey of organic chemicals in water. Sample collection and analyses were started.

Program: WATER QUALITY IMPROVEMENT

Objective: To undertake projects to evaluate, improve and demonstrate water and wastewater treatment processes and hardware.

Progress: A reverse osmosis water treatment system was operated, providing 13 cubic metres of pre-treated water daily for laboratory operations. Equipment and operation changes were brought in to accommodate the change in water supply source from Vegreville to Edmonton. Equipment to double the treatment capacity was acquired.

A project was undertaken with the Sam Livingston Hatchery in Calgary to study problems in the hatchery's design and operation. An understanding of process problems may apply to the Centre's wastewater treatment and recycle plant.

Further work included planning for research into the effect of pulp mill effluent on drinking water treatment and planning of a workshop to identify research needs in this area. As well, staff provided advice to Alberta Public Works, Supply and Services on improving water quality at the Ukrainian Heritage Village.

Program: AQUATIC TOXICOLOGY

Objectives: To describe comprehensively the toxic effects of industrial, municipal and agricultural wastewaters on aquatic life, particularly fish.

Progress: Work continued on a comprehensive survey of chemical residues in fish collected from 24 major rivers and lakes in Alberta. As well as fish, water and sediment collection from the water bodies, the project required laboratory analysis of over 3,200 samples for methyl and inorganic mercury, PCB's and 43 pesticides and their derivatives. Reports on pesticides and PCB's in fish tissues and on mercury in the North Saskatchewan River were compiled. No evidence of significant contamination was found except for the North Saskatchewan River where slight mercury adulteration was recorded.

Twenty-six tests on the toxicity of industrial effluent to rainbow trout were carried out in support of provincial licensing and enforcement programs. The effluents were found to be acutely lethal in four instances. Those findings were communicated to appropriate provincial agencies.

Effects of the pesticide Lindane on survival and early development of rainbow trout were examined in laboratory exposure chambers. Trout eggs and fry were exposed to Lindane at concentrations found in North American rivers. The trials showed that sediments take up around 90 per cent of the pesticide and fish eggs take up as much as 150 times the concentration in water. The main fate of the chemical was evaporation and adsorption to the exposure tank walls.

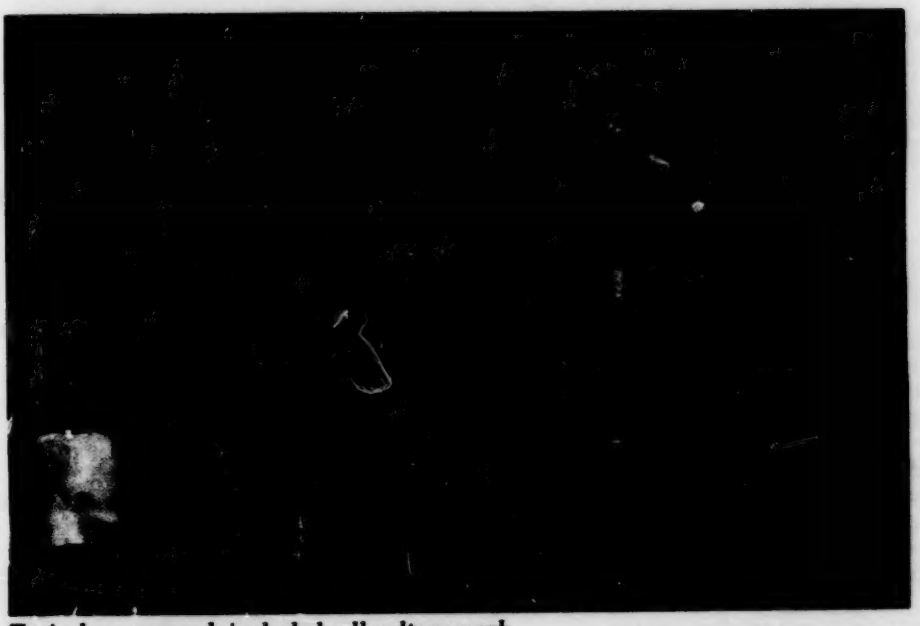
Samples of effluent, fish, sediment and water were collected near a pulp mill discharge site in a study of the effects of wastewater on fish. A residue analysis of the effluent, water and fish samples was completed and a living stream approximating conditions in the affected river was established in the laboratory.

Environmental Toxicology

The focus of this Program Area was the study of the effects of chemicals or agents of natural or human origin which are introduced into air, land or water systems. This included investigations in the field and laboratory using a variety of living organisms.

PROGRAMS

- Effects of Environmental Sulphur
- Inhalation Toxicology
- Toxicology of Pesticides
- Ecological Toxicology



Toxicology research included cell culture work.

Program: EFFECTS OF ENVIRONMENTAL SULPHUR

Objectives: To study the effects of sulphur emissions with particular emphasis on direct and indirect effects on livestock.

Progress: A wide range of activities was undertaken to investigate perceived connections between certain cattle diseases and sulphur emission from sour natural gas processing plants. A pilot study on two dairy and two beef farms in west-central Alberta included forage, feed, grain, air, and soil analyses for sulphur interactions. A questionnaire to veterinarians throughout Alberta gathered information on incidence of nutritional cattle disease to provide information on whether the diseases are more common near sour gas plants.

Methods to measure some enzyme levels were developed and refined as a means of detecting cattle trace element deficiencies and other conditions which might be affected by sulphur. Over 300 blood samples were collected from animals at different locations in Alberta as part of the study on enzyme activity and exposure to sulphur compounds. Blood samples included collections from animals on farms near a sour gas well blowout area, during the blowout and after the well was capped.

In addition to the field studies, a selenium-deficiency study was carried out on rats in the laboratory. Furthermore, a trial on the effects of dietary sulphur on cattle was started.

Program: INHALATION TOXICOLOGY

Objectives: To undertake inhalation studies to determine toxic effects of gases, vapors, particulates and aerosols on animals and, by extrapolation, man.

Progress: Design and specifications for Western Canada's first inhalation toxicology containment laboratory neared the tendering stage at year end. The facility was designed to contain and manage gases and other airborne materials, allowing study of occupational hazards, effects of inhaling noxious substances and effects of long-term, low-level exposures to toxic or potentially toxic airborne compounds.

Space was developed for initial hydrogen sulphide experiments. Instruments for cleaning, mixing, measuring and other air flow management procedures were obtained and ducting and exposure chambers were built.

Work also progressed in the design of experiments which will be conducted in the special facility. A sequence of animal exposures to hydrogen sulphide was devised to obtain information on the effects of the gas at occupational exposure levels. Among areas identified for study were effects on fertility, pregnancy, birth and the foetus.

The second gas under study was sulphur dioxide with emphasis on obtaining insight into the biological effects of sulphur-containing environmental chemicals on susceptible animal sub-populations. Studies were devised to monitor effects of various concentrations of the gas on organisms. A further area identified for research was the interactions of sulphur dioxide with other sulphur-containing gases, nitrogen oxides, ozone and particulates.

Program: TOXICOLOGY OF PESTICIDES

Objectives: To study the effects of pesticides on non-target species.

Progress: A report on the 35 most used pesticides in Alberta was prepared, summarizing available information and identifying gaps in the data. This was followed with a report recommending areas of potential pesticides research.

Co-operative research with Alberta Agriculture investigated questions of whether some cattle breeds are more sensitive than others to organophosphorus pesticides, and whether sensitivity is affected by age and sex. As well as field work, this involved laboratory tests for acetylcholinesterase, an enzyme in cattle blood and brain tissue, to be used to establish relative toxicity of organophosphorus insecticides to domestic animals and wildlife.

Program: ECOLOGICAL TOXICOLOGY

Objectives: To evaluate the biological and ecological impact of environmental contaminants on terrestrial wildlife.

Progress: Staff appointed to the Wildlife Ecology Section early in the fiscal year proposed a program of ecological toxicology after intensive consultation with other provincial and federal agencies. Among proposed areas of work were: (a) a survey to monitor wildlife pesticide residues; (b) definition of bio-indicator wildlife species to monitor pesticides; and (c) a computer data registry of past and current pesticide residue data. A review of client department concerns identified several potential wildlife species for initial research projects in the Program.

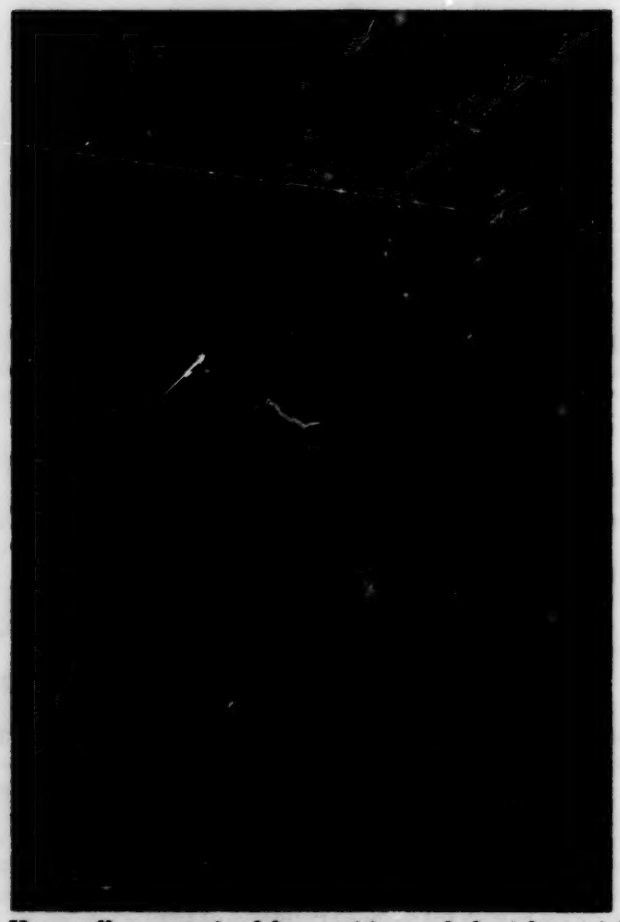
Research was carried out on the effects of environmental sulphur on farm animals.

Living Natural Resources

Research into the effects of various environmental changes on a range of living natural resources made up the majority of work in this Program Area. The environmental changes being considered included physical, chemical and biological ones, while the resources include grasslands, forests, aquatic species, birds and wild mammals.

PROGRAMS

- **Problem Wildlife**
- **Environmental Physiology**
- **Forest Development and Wildlife Resources**
- **Aquatic Habitat Studies**



Young elk were trained for nutrition and physiology trials.

Program: PROBLEM WILDLIFE

Objectives: To design and conduct research on vertebrate pests of agricultural concern.

Progress: Studies on control of pocket gophers and coyotes and on evaluation of poisons to replace strychnine for coyote and skunk control were among the projects carried out.

Field work was completed in experiments to determine if lamb size, color, breed, dam age and number of lambs per litter predisposes lambs to attack by coyotes. A preliminary analysis suggested that smaller lambs are more likely to be preyed on by coyotes than are larger lambs.

Three field trials were conducted using orphan lambs with toxic collars in flocks where coyote attacks were occurring. Coyotes attacked the orphan lambs in two of the trials indicating that use of orphan lambs with collars is a promising strategy for coyote control.

Field tests on pocket gophers suggested that Ratak is a promising new poison for this pest. It gave control as good as or better than strychnine on oat groats. Excellent pocket gopher control was also obtained with Compound 1080. While Compound 1080 should not be registered for pocket gopher control for reasons of human safety, it may be used as a standard of comparison in evaluating other toxicants.

Studies of pocket gopher movements onto newly-established legume fields suggested that about 90 percent of the animals burrow into the fields from the headlands. The rest move above ground, suggesting that invasion can be prevented or delayed by control on the headlands with spot control of individuals that become established.

Program: ENVIRONMENTAL PHYSIOLOGY

Objectives: To obtain quantitative information on animal-environmental interactions to enhance the ability to manage animal and environmental resources.

Progress: Collections of moose tissue from Elk Island Park were completed and extensive laboratory analyses were started. These monthly collections included over 50 measurements per animal and sampling of over 20 tissues. Initial analysis of data was performed to define the overall condition of animals, seasonal trends in body growth and development, seasonal hormone balance and reproduction, and browse composition.

Wildlife nutrition work continued with an analysis of moose browse samples. The samples were collected to examine factors such as browse distribution, nutritional value, seasonal availability and their effect on moose distribution.

Considerable progress was recorded in developing a nutritional research capability with captive animals. A temporary large animal facility was built on the AEC site, and five elk were moved to the facility. The elk were trained for the study of animal feed intake and range use and related work.

A resource evaluation of a potential site for confined field studies near Ministik Lake was completed. This included a description of resources of the area and identification of specific sections suitable for facility development.

Program: FOREST DEVELOPMENT AND WILDLIFE RESOURCES

Objectives: To obtain quantitative data to assist with long-range planning and development of forested areas with reference to wildlife.

Progress: Work progressed in two major projects dealing with industrial development and wildlife in the boreal forest, and use of remote imagery in habitat classification. The first, examining the effects of human activity on grizzly and black bear populations in a forested area around the Berland River, involved a spring trapping and radio-collaring program. Thirty-nine bears were trapped and 26 were fitted with radio collars, allowing the recording of movement patterns and habitat relations and collection of information on bear weight, age and other characteristics. The animals were monitored weekly by aircraft from April to September. As well, bear dens were located and characterized relative to living and non-living features.

In the second major project, an intensive evaluation and classification of selected habitats in the area was completed in preparation for initial remote sensing of the area. In conjunction with the Alberta Remote Sensing Centre and G.L. Langford and Associates, three specific information bases were generated. These included a preliminary cover type map, a comparison of major land use changes between 1976 and 1982, and a review of access and human activity in the study area.

In related work, prototypes for two new data gathering systems were completed. These included a remotely activated video recorder monitoring system for animal behaviour research and a portable recording instrument for physiological monitoring of trapped animals.

Program: AQUATIC HABITAT STUDIES

Objectives: To determine population statistics in fish in response to perturbations.

Progress: Two major project proposals were completed in this new Program. One was aimed at learning how fish movements and feeding relate to mercury uptake and transport in the body. Investigations of seasonal goldeye movements and uptake and use of food in the presence and absence of mercury were proposed.

The second area being investigated was whether growth rates of fish populations in lakes are affected by water drawdown and whether mortality rates change when growth rates change. With information gathered before a drop in water level, the effects of environmental disturbances will be studied and models produced to predict the effects of changing water levels in lakes.

Several studies on coyotes were conducted.

Waste Management Research and Development

The perspective in this Program Area was that agricultural, industrial and municipal wastes are potential resources which may be economically exploited thereby reducing the costs and negative environmental impact of disposal. Within the general objective of evaluating and testing waste handling and disposal techniques, the focus was on physical, chemical and biological processes which may be applied to waste management.

PROGRAMS

- Physical/Chemical Processes in Waste Management
- Microbiological Aspects of Waste Management

A fermenter was acquired for cellulose biotechnology work.

Program: PHYSICAL/CHEMICAL PROCESSES IN WASTE MANAGEMENT

Objectives: To develop technically and economically viable processes for dealing with pollution problems.

Progress: Initial efforts to develop and test scrubbing technology focused on sulphur dioxide removal from stack gases. A process was examined which may use Alberta's magnesite deposits to reduce sulphur dioxide emissions and at the same time produce saleable byproducts. Contacts were made with private industry, a literature review of the process feasibility was conducted and plans were drawn up for bench scale and field scrubber test facilities.

An examination of waste solidification processes began with a literature search and establishment of contacts with private firms, other government agencies, universities and research institutions. Emphasis was on tests of the effectiveness of processes and predicting long-term environmental impact of this method of waste disposal.

A solid/liquid incinerator was acquired and tested for the treatment of Centre-generated wastes. Plans were drawn up to upgrade the incinerator to a pilot unit for the study of optimum combustion conditions for Alberta's wastes. This required installation of a scrubber and gas monitoring and automated data logging and control systems.

As well, a survey was started to determine which of Alberta's problem wastes can be incinerated, scrubbed or solidified. Results will help identify processes which might be used in the province with ranking of wastes to be tested.

The impact of pulp mill effluents on water resources was indentified as an area requiring research. The main concern was with color, taste and odor-causing compounds in the effluents.

Program: MICROBIOLOGICAL PROCESSES IN WASTE MANAGEMENT

Objectives: To provide information on municipal, industrial and agricultural waste management practices and alternatives using microbiological processes.

Progress: Two toxicity test systems (Microtox and *Spirillum volutans*) using bacteria were evaluated and refined to provide information on how they might be used in acute toxicity testing. The tests measure changes in the intensity of light production and motility patterns, respectively, of certain bacteria in the presence of toxicants. Following laboratory trials, changes in the testing procedures were implemented to enhance the accuracy, sensitivity and usefulness of these tests. The bacterial tests were subsequently used to perform some 235 assays on various metals and their mixtures, industrial effluents and landfill leachates.

Research on the microbiological effects on receiving waters of cattle feedlots runoff progressed with the selection of four feedlots for detailed study. Work included undertaking of six surveys involving the analysis of 42 water samples for 400 microbiological parameters.

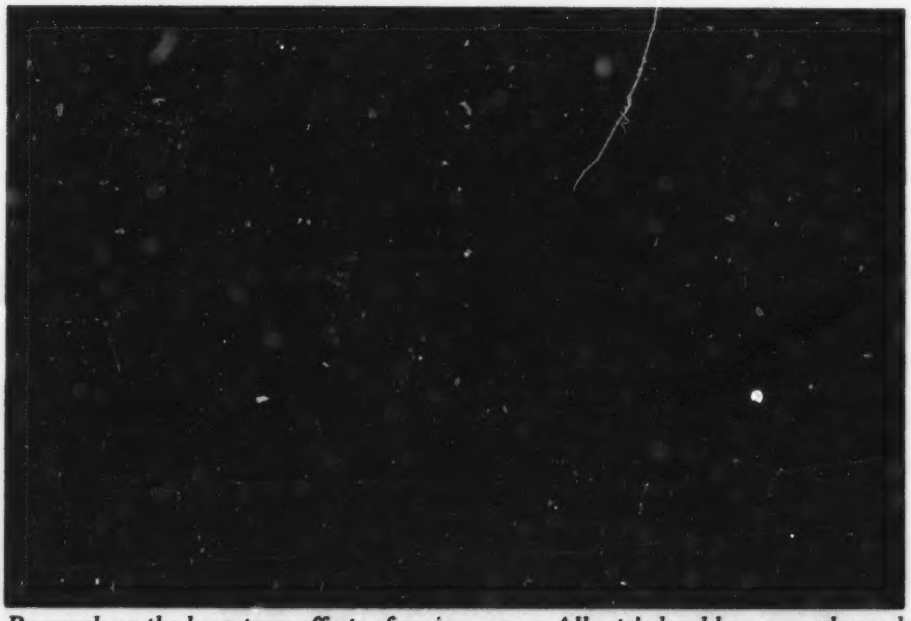
A detailed operating plan was prepared for the cellulose biotechnology project aimed at assessing microbiological converson of cellulosic wastes into more useful products, particularly for production of ruminant feed. Work in a landfill microbiology project included completion of a literature review, and some exploratory work to measure landfill temperatures and gas production.

Work on the use of bacteria to remove heavy metals from sludges continued with detailed studies of two bacteria, selected after screening of 362 isolates, for their level of tolerance to and uptake of chromium VI.

Land Resources Management Research and Development

This Program Area had the objective of examining the long-term effects of major uses on Alberta's land resources. The emphasis was on reclaiming disturbed sites and providing technical solutions to land-use problems.

PROGRAM
- Land Reclamation Research



Research on the long-term effects of major uses on Alberta's land base was planned.

Program: RECLAMATION

Objectives: To conduct research on the long-term effects of major uses on Alberta's land base.

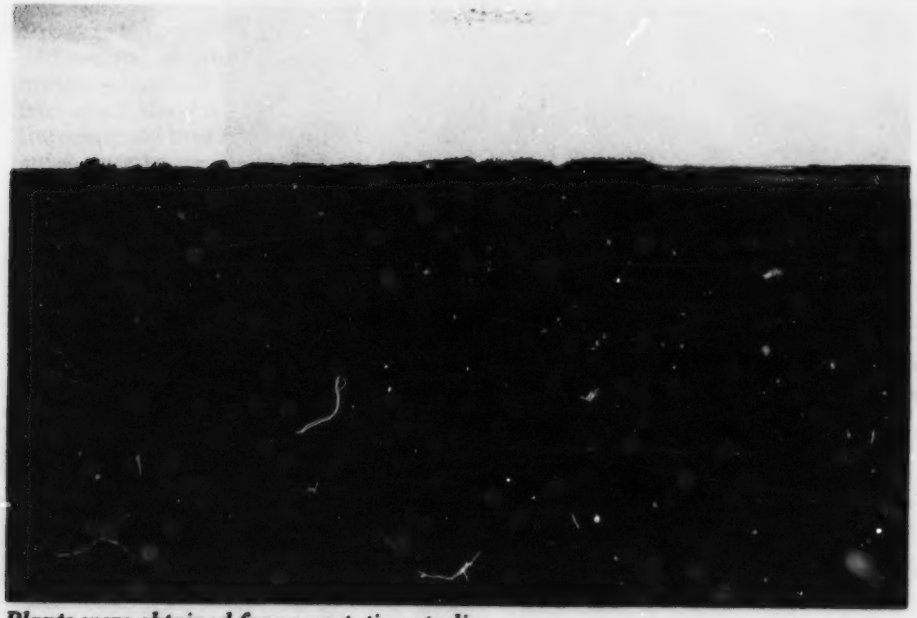
Progress: Plans were completed for the expansion of the Plant Sciences Wing to include two new Groups, Soils and Vegetation, working in land reclamation research and development.

Major client departments are Energy and Natural Resources, Environment and Agriculture. The Land Conservation and Reclamation Council is the administrative body through which research projects will be funneled. The Reclamation Research Technical Advisory Committee composed of representatives from Energy and Natural Resources, Environment, Agriculture, the Alberta Research Council and private industry acts as the coordinating body for setting priorities, supplementing project funding and advising on the applicability of the research

The first area of research proposed by the Soils Group focuses on factors influencing water and salt movement in saline-sodic mine spoils and soils. Much of Alberta is underlain by geological materials with extremely high contents of sodium and soluble salts. These materials present major permeability problems in land reclamation for agriculture, rangeland, forestry and recreation.

The Soils Group planned a series of experiments to identify which factors are most critical in predicting the behavior of these materials and which methods are most effective in maintaining permeability after exposure.

The initial program to be undertaken by the Vegetation Group will be the development of native plant species suitable for reclamation in various areas of the province. The goal is to produce lines of grasses, forbs, and shrubs which establish quickly, survive on disturbed sites and are suitable for commercial seed production. Initial work was planned to include high-altitude native grasses from the east slopes, forbs from southern Alberta, and shrubs from northern Alberta.



Plants were obtained for revegetation studies.

Administrative Support

Activities in this Program Area provided the administrative and technical support services required to achieve the Centre's research, technical development and client services objectives. The approach was to provide these services, such as budgeting, library services and staff recruitment, in ways which are the most economical and which enhance the major activities of the Centre.

PROGRAMS

- **Administrative Services**
- **Capital Facilities Development**

The main laboratory building, housing five Wings, was officially opened in 1981.

Program: ADMINISTRATIVE SERVICES

Objective: To provide administration and support services required for the efficient operation of the Centre's four scientific and technical Wings.

Progress: Steps were taken to expand and improve services provided in support of the growing number of scientific and technical activities of the Centre.

Administration functions centred on budgeting, monitoring and expenditure of $11.3 million approved for Centre operations. The Financial Services Section purchased, received, stored and distributed goods and services, recording an increase from the previous year of approximately 25 per cent. New facilities were occupied and procedures such as a new fixed assets control system were introduced to the Centre Stores operation.

As the focal point for collection of published information on technical subjects, the Library maintained a collection of serials and monographs, handled over 2,200 inter-library loans and performed some 130 in-depth, on-line computer searches. The Library published the 1983 edition of 'Persons Involved in Environmental Research in Alberta' and operated the Centre's mailroom and central filing system where an automated, on-line index to files was developed.

Personnel recruitment to staff new programs and projects was active with 54 salaried employee hirings, bringing the staff roster in various categories to 215 at fiscal year end. A number of staff training courses including an orientation for new employees was offered, and recruitment of a staff nurse resulted in increasing efforts to develop health and safety programs.

The public communications program included an open house which attracted 500 visitors. In addition, over 90 other tours for a further 1000 people were conducted throughout the year. The annual review and staff newsletters were published, and 129 other printing orders were filled including a growing number for technical reports. Some 44 media contacts were recorded and several articles on Centre activities were printed, especially in the local press.

Site support staff carried out duties including landscaping, field plot preparation and development of revegetation plots. Site research support spanned a range of activities from building bear snares to installation of soil temperature measuring devices.

Program: CAPITAL FACILITY DEVELOPMENT

Objectives: To develop the capital facilities required for Centre activities.

Progress: A temporary large animal holding facility was built to accommodate wildlife for research purposes. Skunk and coyote kennels and cattle shelters were also constructed.

Design of the first phase of a $900,000 inhalation toxicology research laboratory was completed and the project neared the tendering stage. As well, some laboratory areas were upgraded for new programs.

ALBERTA ENVIRONMENTAL CENTRE PROGRAMS

NAME	PRINCIPALS AND CO-OPERATING DEPARTMENTS
1. ANALYTICAL, DIAGNOSTIC, EXTENSION AND TECHNICAL SERVICES	
Pest Management, Diagnostic and Extension Services	Agriculture, Environment, Health Units
Trace Organics Analysis and Methods Development	Environment, Agriculture, Energy and Natural Resources, Health Units, Alberta Environmental Centre
Microbiological Identification Services	Alberta Environmental Centre
Analytical Services (Air)	Environment
Precipitation Studies	Environment
Technical Support Services	Environment
Wildlife Biology Services	Alberta Environmental Centre, Agriculture, Energy and Natural Resources, Environment
Toxicology Services	Agriculture, Environment, Workers' Health, Safety and Compensation, Energy and Natural Resources
Geochronology Services	Alberta Research Council, Environment, Agriculture, Archaeological Survey of Alberta
Analytical Services (Water)	Environment, Health Units, Energy and Natural Resources
Lake Nutrients	Environment
Aquatic Biology Services	Alberta Environmental Centre
Pathology Services	Alberta Environmental Centre
Nutrition Services	Alberta Environmental Centre
Experimental Animal Services	Alberta Environmental Centre
Site Environmental Services	Alberta Environmental Centre
Research Services	Alberta Environmental Centre
Quality Control and Data Management	Environment, Energy and Natural Resources, Health Units
Instrumentation Services	Alberta Environmental Centre
2. WATER/WASTEWATER RESEARCH AND DEVELOPMENT	
Aquatic Toxicology	Environment, Energy and Natural Resources
Environmental Chemistry of Wastewater	Environment, Energy and Natural Resources
Water Quality Improvement	Environment, Alberta Environmental Centre, Public Works, Supply and Services
3. PEST MANAGEMENT RESEARCH AND DEVELOPMENT	
Plant Pathology Research and Development	Agriculture
Insect Pest Management Research and Development	Agriculture
Weed Management Research and Development	Agriculture
Pesticide Analysis and Methods Development	Environment, Agriculture, Health Units, Alberta Environmental Centre

NAME	PRINCIPALS AND CO-OPERATING DEPARTMENTS
4. ENVIRONMENTAL TOXICOLOGY	
Toxicology of Pesticides	Environment, Energy and Natural Resources, Workers' Health, Safety and Compensation
Genetic Toxicology	Environment
Ecological Toxicology	Energy and Natural Resources
Inhalation Toxicology	Workers' Health, Safety and Compensation, Environment, Agriculture
Effects of Environmental Sulphur	Agriculture, Environment
Chemical Safety Evaluation	Agriculture, Environment, Energy and Natural Resources, Workers' Health, Safety and Compensation
Toxicology of Petrochemicals and Fossil Fuels	Agriculture
5. LIVING NATURAL RESOURCES	
Aquatic Habitat Studies	Energy and Natural Resources
Problem Wildlife	Agriculture
Environmental Physiology	Energy and Natural Resources
Forest Development and Wildlife Resources	Energy and Natural Resources Environment
6. WASTE MANAGEMENT RESEARCH AND DEVELOPMENT	
Microbiological Processes in Waste Management	Environment, Agriculture, Alberta Research Council, Alberta Environmental Centre
Physical/Chemical Processes in Waste Management	Environment, Energy and Natural Resources, Agriculture
7. LAND RECLAMATION MANAGEMENT RESEARCH AND DEVELOPMENT	
Reclamation	Energy and Natural Resources, Agriculture, Environment
8. ADMINISTRATIVE SUPPORT	
Administrative Services — Common Services	Alberta Environmental Centre
Technical Services — Common Services	Alberta Environmental Centre
Administrative Services — Plant Sciences	Alberta Environmental Centre
Administrative Services — Chemistry	Alberta Environmental Centre
Administrative Services — Animal Sciences	Alberta Environmental Centre
Administrative Services — Environmental Technology	Alberta Environmental Centre
Capital Facilities Development	Alberta Environmental Centre
Research and Development Studies	Alberta Environmental Centre

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*Experimental work done elsewhere

PATENTS

CANADIAN PATENTS

Patent No.	Inventors	Date Issued	Title
1,114,960	Pollock, David C.I. Wilson, Malcolm A.	81:12:22	Method for the froth flotation separation and treatment of slowly biodegradable components in a waste treatment system
1,114,965	Pollock, David C.I. Wilson, Malcolm A.	81:12:22	Long vertical shaft bioreactor with modified waste liquor injection.

UNITED STATES PATENTS

4,340,484	Pollock, David C.I. Wilson, Malcolm A.	82:07:20	Method for the froth flotation separation and treatment of slowly biodegradable components in waste treatment.
4,367,146	Pollock, David C.I. Wilson, Malcolm A.	83:01:04	Long vertical shaft bioreactor with modified waste liquor injection.
4,377,439	Liem, Albert J.	83:03:22	Pulp mill recovery.

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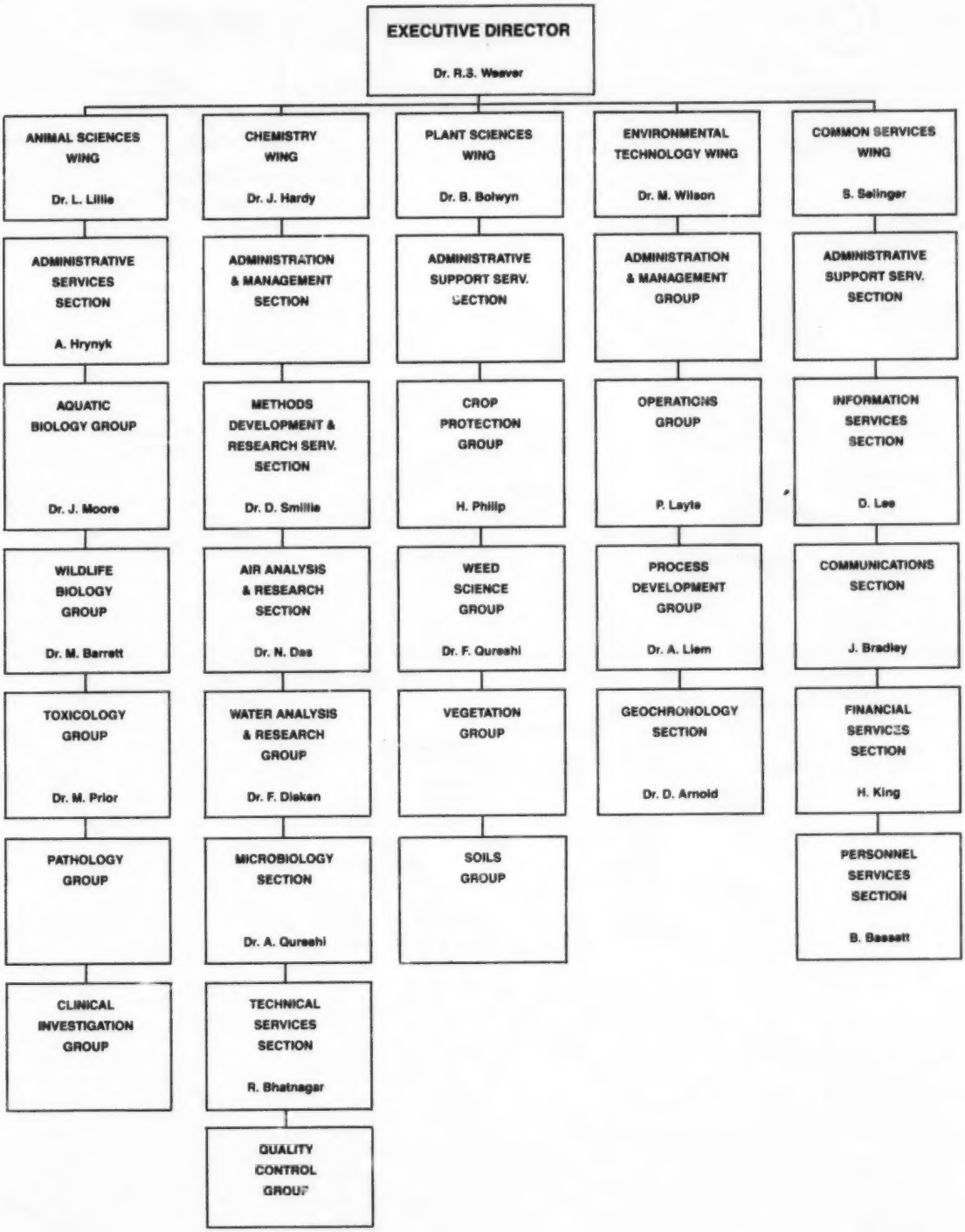
1982-83 FISCAL YEAR EXPENDITURES
(Thousands of dollars)

	Manpower	Supplies & Services	Grants	Fixed Assets	Total
Program Support	1072	1043	21	253	2389
Plant Sciences	801	215	0	562	1578
Chemistry	1558	410	0	420	2388
Animal Sciences	1293	639	0	584	2516
Environmental Technology	745	315	0	691	1751
TOTAL	5469	2622	21	2510	10,622

This is not an audited statement.

ORGANIZATION CHART



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